Influence of morphology of electrodeposited copper on the electrochemical regeneration of nicotinamide adenine dinucleotide (1,4-NADH)

Uticaj morfologije elektrohemijski istaloženog bakra na elektrohemijsku regeneraciju nikotinamid adenin dinukleotida (1,4-NADH)

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Abstract

This study investigates how copper electrode morphology influences the electrochemical regeneration of 1,4-NADH. Bioelectrochemical systems that couple enzymatic catalysis with electrochemical redox reactions are emerging as promising platforms for developing sustainable industrial processes, and efficient NADH regeneration is central to their performance. Electrochemical deposition (ED) offers a low-cost, rapid, and environmentally friendly route to fabricate metal electrodes with tailored surface morphologies. By adjusting deposition parameters—current density or overpotential, temperature, time, electrolyte type and composition, additives (levelers/brighteners), and agitation—as well as employing constant or periodically pulsed deposition regimes, the morphology of deposited copper can be precisely tuned. We show that the resulting copper morphologies markedly impact the efficiency and selectivity of 1,4-NADH electroregeneration, identifying copper as a promising electrocatalyst for bioelectrochemical applications.

Keywords: *bioelectrochemical systems; electrodeposition; copper; morphology*

Izvod

Ova studija istražuje kako morfologija bakarnih elektroda utiče na elektrohemijsku regeneraciju 1,4-NADH. Bioelektrohemijski sistemi koji spajaju enzimsku katalizu sa elektrohemijskim redoks reakcijama pojavljuju se kao obećavajuće platforme za razvoj održivih industrijskih procesa, a efikasna regeneracija NADH je ključna za njihove performanse. Elektrohemijsko taloženje (ED) nudi jeftin, brz i ekološki prihvatljiv način za izradu metalnih elektroda sa prilagođenim površinskim morfologijama. Podešavanjem parametara taloženja - gustine struje ili prenapetosti, temperature, vremena, vrste i sastava elektrolita, aditiva (sredstva za poravnavanje/sjaj) i mešanja - kao i primenom konstantnih ili periodično pulsnih režima taloženja, morfologija istaloženog bakra može se precizno podesiti. Pokazali smo da rezultujuće morfologije bakra značajno utiču na efikasnost i selektivnost elektroregeneracije 1,4-NADH, identifikujući bakar kao perspektivni elektrokatalizator za bioelektrohemijske primene.

Ključne reči: *bioelektrohemijski sistemi; elektrohemijsko taloženje; bakar; morfologija*

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